

CLAIMS

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B 1. An in-mold decorating sheet having high three-dimensional workability for use in a manufacturing method of an in-mold decorated article, the method comprising: setting an in-mold decorating sheet into a mold ~~(4, 5)~~ for in-mold decorating sheet injection-molding; after clamping the mold, injecting molding resin ~~(10)~~ and allowing the molding resin to be cooled and solidified, by which entirety or part of the in-mold decorating sheet is integrally bonded to a surface of the molding resin, wherein

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B the in-mold decorating sheet ~~(3, 45, 61)~~ comprises at least a substrate sheet ~~(1, 62)~~ and a backing sheet ~~(33, 66)~~, exhibits a colored state, and has the following characteristic values:

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B (1) when a tensile test is carried out with a 10 mm wide test specimen of the in-mold decorating sheet fixed between a pair of chucks at a chuck-to-chuck distance of 5 mm, by applying a load at a constant rate of 500 mm/min to one end of the test specimen under an ambient temperature condition of 62 - 94°C, the test specimen exhibits a tensile load at break of not less than 23 gf;

20 (2) the in-mold decorating sheet changes in properties due to heat within a temperature range of 40 - 200°C; and when a tensile test is carried out with a 10 mm
25 wide test specimen of the in-mold decorating sheet fixed

between a pair of chucks at a chuck-to-chuck distance of 5 mm, by applying a load of 20 gf at a constant rate of 500 mm/min to one end of the test specimen under an ambient temperature condition within a range from the temperature of property change to a temperature at which the in-mold decorating sheet is thermally decomposed, the test specimen exhibits a tensile elongation at break of not less than 130%.

2. The in-mold decorating sheet according to Claim 1, wherein the manufacturing method of the in-mold decorated article comprises: after working the in-mold decorating sheet into a three-dimensional configuration, removing portions of the in-mold decorating sheet unnecessary for decorating by trimming process; then setting the in-mold decorating sheet into the mold for injection-molding; and after clamping the mold, injecting molding resin and allowing the molding resin to be cooled and solidified, by which the entirety or part of the in-mold decorating sheet is integrally bonded to the surface of the molding resin, and wherein when a tensile test is carried out with a 10 mm wide test specimen of the in-mold decorating sheet fixed between a pair of chucks at a chuck-to-chuck distance of 5 mm, by applying a load at a constant rate of 500 mm/min to one end of the test specimen under an ambient temperature condition of 25°C, a product of Young's modulus and a cube of thickness of the in-mold

decorating sheet measured at the tensile test is not less than 1 kgfmm².

3. An in-mold decorating sheet according to Claim 1 or 2, wherein a pencil hardness value of the in-mold decorating sheet measured on one side thereof opposite to the side to be bonded to the molding resin is 3B - 2H.

4. An in-mold decorating sheet according to Claim 3, wherein the substrate sheet is a film selected from among undrawn or lightly-drawn polyethylene terephthalate film, noncrystalline or low-crystalline polyester copolymer film, acrylic film, polycarbonate film, polypropylene film, polybutylene terephthalate film, polystyrene film, polyurethane film, acrylonitrile butadiene-styrene copolymer film, nylon film, polyvinyl chloride film, fluorine film, and cellulose acetate film.

5. An in-mold decorating sheet according to ^{claim 1} ~~any one~~ of ~~Claims 1 to 4~~, wherein a thickness of the in-mold decorating sheet is not less than 250 μm , a thickness of the in-mold decorating sheet excluding thickness of the backing sheet is not more than 200 μm , and color of the backing sheet is a dark color falling within the following ranges in the CIE1976(L*a*b*) color system:

$$9 \leq L^* \leq 75$$

$$-40 \leq a^* \leq 40$$

$$-60 \leq b^* \leq 30.$$

6. An in-mold decorating sheet according to Claim 5, wherein the backing sheet is a film selected from among acrylic film, undrawn or lightly-drawn polyethylene terephthalate film, noncrystalline or low-crystalline polyester copolymer film, polypropylene film, polyethylene film, polystyrene film, fluoric film, polybutylene terephthalate film, methacryl-styrene copolymer film, acrylonitrile butadiene-styrene copolymer film, polycarbonate film, polyurethane film, nylon film, polyvinyl chloride film, and nitrocellulose film.

7. An in-mold decorating sheet according to ^{claim 1} ~~any one~~ of Claims 1 to 5, wherein material of the backing sheet is a material which prevents vaporization and foaming.

8. An in-mold decorating sheet according to ^{claim 1} ~~any one~~ of Claims 1 to 7, wherein difference in shrinkage factor between the substrate film and the backing sheet is 0/1000 - 8/1000.

9. An in-mold decorating sheet according to Claim 8, wherein the substrate sheet is an acrylic film and the backing sheet is a polypropylene film containing olefin rubber ~~(84)~~ and filler material ~~(85)~~.

10. An in-mold decorating sheet according to Claim 9, wherein when the olefin rubber is ethylene propylene rubber or ethylene-propylene-diene terpolymer, its content is 20 - 150 parts by weight on the basis of 100 parts by weight of

propylene resin.

11. An in-mold decorating sheet according to Claim 9, wherein when the filler material is talc, its content is 5 - 20 parts by weight on the basis of 100 parts by weight of propylene resin.

12. An in-mold decorating sheet according to ~~any one~~ ^{claim 1} of Claims 1 to 11, wherein a pattern layer (2, 32) is formed between the substrate sheet and the backing sheet.

13. A method for manufacturing an in-mold decorating sheet, wherein when the pattern layer of the in-mold decorating sheet defined in Claim 12 is formed, a carrier sheet whose dimensional change rate under an ambient temperature of 90°C is within 0.6% is laminated on the substrate sheet, and the pattern layer is formed on a surface of the substrate sheet or the backing sheet opposite to the carrier sheet.

14. A method for manufacturing an in-mold decorating sheet, wherein when the pattern layer of the in-mold decorating sheet defined in Claim 12, the pattern layer is formed on a carrier sheet whose dimensional change rate under an ambient temperature of 90°C is within 0.6%, and thereafter the substrate sheet is laminated on the pattern layer side and further the carrier sheet is separated and removed so that the pattern layer is formed on a surface of the substrate sheet or the backing sheet.

15. A method for manufacturing an in-mold decorating sheet according to Claim 13 ~~or 14~~, wherein the carrier sheet is a biaxially oriented polyester film or a biaxially oriented polypropylene film.

5 16. An in-mold decorating sheet according to ^{claim 1} ~~any one~~ ~~of Claims 1 to 15~~, wherein a second pattern layer ~~(68)~~ is formed between the backing sheet and the pattern layer.

10 17. An in-mold decorating sheet according to Claim 16, wherein the substrate sheet is made from an easily vaporizable, foamable material, and the second pattern layer is made from a material that prevents vaporization and foaming.

15 18. An in-mold decorating sheet according to Claim 17, wherein the second pattern layer ~~(68)~~ is made from any one selected from among polyethylene resin, polypropylene resin, styrene resin, fire-retardant ABS resin, and thermoplastic polybutadiene resin.

20 19. An in-mold decorating sheet according to ^{claim 1} ~~any one~~ ~~of Claims 1 to 16~~, wherein the backing sheet is a lamination of a plurality of sheets and a difference in shrinkage factor between the substrate sheet and the farthest backing sheet from the substrate sheet is 0/1000 - 8/1000.

25 20. An in-mold decorating sheet according to Claim 19, wherein the backing sheet is formed from a plurality of

polypropylene film layers, the substrate sheet is an acrylic film, and at least the farthest propylene film layer from the acrylic film contains olefin rubber and/or filler material.

- 5 21. An in-mold decorated article formed by a method comprising: setting into the mold for injection-molding the in-mold decorating sheet defined in ^{claim 1} ~~any one of Claims 1 to~~
10 ~~12 and Claims 15 to 20~~; and after clamping the mold, injecting molding resin and allowing the molding resin to be cooled and solidified, by which the entirety or part of the in-mold decorating sheet is integrally bonded to the surface of the molding resin.
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